ENBRIDGE GAS INC.
2024 REBASING – PHASE 1

Written Interrogatories of Enbridge Gas Inc.

M8-EGI-66

Reference:

Exhibit M8

Preamble:

Throughout the evidence of Dr. Hopkins there are many references to “investors.” It is not clear if Dr. Hopkins is referring to equity investors or debt investors.

For example,

At page 7, Dr. Hopkins states:

“If circumstances change in the meantime, the **investors’** returns may be higher or lower than expected. These business risks are manifested in volatility in the rate of return earned by utility shareholders.” (emphasis added)

Also at page 7, Dr. Hopkins states:

“This capital risk is sometimes referred to as “stranded cost” or “stranded asset” risk, although I want to make a clear distinction between a stranded cost and an actual loss to **utility investors**.” (emphasis added)

At page 9, Dr. Hopkins states:

“There are two potential sources of **investor risk** associated with stranded assets.” (emphasis added)

At page 23, Dr. Hopkins states:

“I agree that **investors** look to the long term, while they also look to the near term. **Investors** look at risks across all timeframes and consider the picture as a whole, and they consider the likelihood of different outcomes over time. Standard financial evaluation includes discounting future returns, relative to near-term returns, when considering the value of an investment.” (emphasis added)

Question(s):

Please confirm that Dr. Hopkins is referring to equity investors throughout the evidence. If not confirmed, please clearly state for each reference to “investor” or “investors” in the evidence which type of investor Dr. Hopkins is referring to.

M8-EGI-67

Reference:

Exhibit M8, page 3

Question(s):

Please list the cases in which Dr. Hopkins has provided recommendations on either the authorized return on equity or the appropriate capital structure for a regulated utility. Please include the jurisdiction in which the evidence was filed, the docket or case number for each proceeding and the date Dr. Hopkins' evidence was filed.

M8-EGI-68

Reference:

Exhibit M8, page 8

Preamble:

At page 8, Dr. Hopkins states:

"In practice, however, when a utility asset that was installed prudently becomes no longer used and useful, regulators commonly allow the continued recovery of some or all of the value of that asset. So, the mere existence of stranded assets does not immediately or necessarily create losses to investors."

Question(s):

In Dr. Hopkins' opinion, does the potential disallowance of some or all of the value of stranded assets affect how investors would perceive the business risk of the utility that owns those assets? In other words, is it necessary for there to be an actual disallowance of stranded assets before investors factor that risk into their assessment? Please explain.

M8-EGI-69

Reference:

Exhibit M8, page 9

Preamble:

At page 9, Dr. Hopkins states:

In some jurisdictions, regulators and legislatures have created securitization structures in which shareholders are paid for their investment in a set of assets no longer in service. The cost of this payment is then transferred to a bond-funded structure (with explicit or implicit ratepayer and/or taxpayer support) and the costs are paid back to bondholders over some period. Securitization can lower ratepayer costs by paying only the cost of the new debt, rather than the higher weighted average cost of capital, and potentially spreading costs over a longer period than the asset life.

Question(s):

Please provide examples of securitization financings that have spread costs over a longer period than the asset life. Are such structures common among securitizations?

M8-EGI-70

Reference:

Exhibit M8, page 10

Preamble:

At page 10, Dr. Hopkins states:

“The equity share of the capital structure should most directly reflect the risks regarding return on invested capital in the period until the next time the capital structure is evaluated, with less weight given to risks that extend further out in time. Thus, short-term risks should be the primary driver for considering changes to the capital structure.”

Question(s):

a) Has Dr. Hopkins analyzed whether the current deemed equity ratio of 36% is reasonable for Enbridge Gas given the Company’s relative business risk as compared to other large gas distribution companies in Canada and the U.S.? If so, please provide that analysis.

b) Has Dr. Hopkins analyzed when the long-term business risk (i.e., capital recovery risk) for Enbridge Gas might be expected to increase due to the energy transition? If so, please provide that analysis.

c) In Dr. Hopkins' opinion, is it important for Enbridge Gas to have the financial strength it needs to manage the effects of the energy transition as well as other business risks? Please explain why the current deemed equity ratio of 36% is reasonable for Enbridge Gas.

M8-EGI-71

Reference:

Exhibit M8, pages 11-12

Preamble:

At pages 11 and 12, Dr. Hopkins states:

"Viewed as a whole, this business risk summary does not appear to be consistent with EGI's and Concentric's claims that business risk is increasing, primarily driven by capital risk associated with energy transition."

Question(s):

a) Please confirm that Figure 1 of Concentric's report identifies other business risks that have increased for Enbridge Gas since 2012, apart from energy transition risk, such as volumetric risk, financial risk, and operational risk.

b) Has Dr. Hopkins taken into account those other business and operating risks in his evaluation of Enbridge Gas's business risk and capital structure?

M8-EGI-72

Reference:

Exhibit M8, pages 11, 13, 20, and 27-28
S&P Global, "Alectra Inc. Outlook Revised To Negative On Heightened Regulatory Lag; 'A-' Ratings Affirmed," May 11, 2023.[1]

[1] S&P Global. (2023, May 11). Alectra Inc. Outlook Revised To Negative On Heightened Regulatory Lag; 'A-' Ratings Affirmed. https://disclosure.spglobal.com/ratings/en/regulatory/article/-/view/type/HTML/id/2985484

S&P Global, “Toronto Hydro Corp. Outlook Revised To Developing From Positive Due To Heightened Regulatory Lag; Ratings Affirmed,” May 11, 2023.[2]

Preamble:

At page 11, Dr. Hopkins states:

“S&P gives EGI a rating of Excellent, its top rating.”

At page 13 Dr. Hopkins states:

“Ontario’s “transparent, consistent, and predictable” regulatory regime (as described by S&P) is the foundation of EGI’s low business risk.”

At page 20, Dr. Hopkins states:

“The OEB’s “transparent, consistent, and predictable” regulation of EGI (to quote S&P) gives me confidence that the OEB will ensure that EGI plans appropriately to adapt to the policy and market contexts in which it finds itself over the course of the energy transition in the coming decades.”

At pages 27 and 28, Dr. Hopkins states:

“OEB consideration of EGI’s plans in the context of the Ontario Ministry of Energy’s Cost-Effective Energy Pathways Study will similarly reflect the transparent, consistent, and predictable regulatory process in Ontario, which is a key component of S&P’s evaluation of EGI’s business risk as “Excellent.””

At Alectra Inc. Outlook Revised To Negative On Heightened Regulatory Lag; 'A-' Ratings Affirmed’s report, S&P states:

“However, should we reassess Ontario's regulatory construct downward, we would likely reconsider our assessment of Alectra's business risk profile within its excellent business risk profile category.”

At Toronto Hydro Corp. Outlook Revised To Developing From Positive Due To Heightened Regulatory Lag; Ratings Affirmed’s report, S&P states:

“However, should we reassess Ontario's regulatory construct downward, it would likely weaken our relative assessment of THC's business risk profile within its current business risk profile category.”

[2] S&P Global. (2023, May 11). Toronto Hydro Corp. Outlook Revised To Developing From Positive Due To Heightened Regulatory Lag; Ratings Affirmed. https://disclosure.spglobal.com/ratings/pt/regulatory/article/-/view/type/HTML/id/2985450

Question(s):

a) In Dr. Hopkins' opinion, what effect would a reassessment downward of Ontario's regulatory construct by S&P have on S&P's business risk rating for Enbridge Gas?

b) What effect would a reassessment downward of Ontario's regulatory construct by S&P have on Dr. Hopkins' assessment of business risk for Enbridge Gas, if any?

c) In Dr. Hopkin's opinion do you consider the risk of potential stranded assets as an example of the risk natural gas utility companies are facing due to energy transition regardless of the timing of that risk?

M8-EGI-73

Reference:

Exhibit M8, pages 14 and 24
City of Toronto Item - 2023.IE3.3[3]

Preamble:

At page 14, Dr. Hopkins states:

"The most important feature is not necessarily the timing of the risks, so much as their certainty. It happens that near-term risks tend to be better understood and characterized, and the range and likelihood of possible outcomes is more certain."

"But given the potential for change and the ability to adapt, it is generally the case that risks should be given less weight the further they would manifest in the future."

At page 24, Dr. Hopkins states:

"Furthermore, even if growth were somehow required to recover already invested capital, the Concentric report presents no tangible evidence that gas bans are a risk in Ontario, recognizing that "it is not aware of any building gas bans" in Ontario."

Question(s):

a) Dr. Hopkins states elsewhere in his evidence that the energy transition is a long-term risk rather than a short-term risk, and that the deemed equity ratio for Enbridge

[3] City of Toronto. (2023, May 10). Item -2023.IE3.3. https://secure.toronto.ca/council/agenda-item.do?item=2023.IE3.3

Gas should not be increased due to long-term risks. Please reconcile this statement with the first sentence of Dr. Hopkins' report on page 14 where he indicates that the most important feature is not necessarily the timing of the risk, but the certainty of those risks.

b) Does Dr. Hopkins agree that there is a relatively high degree of certainty that some form of energy transition will occur in Ontario which will affect the business risk of gas utilities such as Enbridge Gas?

c) In Dr. Hopkins' opinion, does the May 10, 2023 City of Toronto adoption of Item – 2023.IE3.3 that would "direct the Chief Planner and Executive Director, City Planning, in consultation with the City Solicitor and the Executive Director, Environment and Climate, to review options to discourage the installation of new combustion uses of methane ("natural gas") as part of the update to the Toronto Green Standard to Version 5," provide tangible evidence that gas bans are a risk in Ontario?

M8-EGI-74

Reference:

Exhibit M8, page 14

Preamble:

At page 14, Dr. Hopkins states:

"Risks which can be better quantified and evaluated should be given greater weight, all else equal. In general, this means near-term, well-understood risks should be given greater weight, while uncertain, less established risks should be given less weight."

Question(s):

a) Would Dr. Hopkins agree that an assessment of business risk generally tends to be more qualitative in nature because many business risks are difficult to quantify?

b) Has Dr. Hopkins performed any analysis that compares the business risk or deemed capital structure of Enbridge Gas to other large gas distribution companies in Canada or the U.S.? If so, please provide that analysis. If not, what is the basis for Dr. Hopkins' conclusion that the current deemed equity ratio of 36% for Enbridge Gas is reasonable and meets the fair return standard?

M8-EGI-75

Reference:

Exhibit M8, page 18

Preamble:

At page 18, Dr. Hopkins states:

"To compare volatility, I used the calculated 0.64 percent standard deviation of EGI's achieved returns over its four-year existence as a combined company."

Question(s):

a) Please provide the working papers supporting Figure 1 and Figure 2 in Dr. Hopkins' report in Excel format. Please also provide the working papers supporting Dr. Hopkins' calculation of standard deviations.

b) Why has Dr. Hopkins used the standard deviation to evaluate volatility of earned returns for Enbridge Gas instead of the coefficient of variation?

M8-EGI-76

Reference:

Exhibit M8, page 20

Preamble:

At page 20, Dr. Hopkins states:

"The OEB's "transparent, consistent, and predictable" regulation of EGI (to quote S&P) gives me confidence that the OEB will ensure that EGI plans appropriately to adapt to the policy and market contexts in which it finds itself over the course of the energy transition in the coming decades."

Question(s):

Is it Dr. Hopkins' position that OEB regulation can mitigate all business risk for Enbridge Gas, including risk associated with the energy transition, or are there certain business risks that cannot be mitigated by regulation?

M8-EGI-77

Reference:

Exhibit M8, page 21

Preamble:

At page 21, Dr. Hopkins states:

"To the extent that EGI acts imprudently by failing to appropriately plan for the energy transition or by poorly managing the transition, it may experience lower returns and/or fail to recover its capital."

Question(s):

As discussed on page 18 of Exhibit 1, Tab 2, Schedule 1, one way that Enbridge Gas has identified to manage the energy transition is to increase its deemed common equity ratio over the course of the PBR plan from 36% to 42% to maintain the Company's financial strength and continued access to capital at a reasonable cost.

Given the above-referenced passage from Dr. Hopkins' evidence, should the management of Enbridge Gas be held responsible for poorly managing the energy transition if the OEB rejects the proposed change in the Company's capital structure, as Dr. Hopkins recommends?

M8-EGI-78

Reference:

Exhibit M8, page 21

Preamble:

At page 21, Dr. Hopkins states:

"Ontario's climate plan has called for a dramatic reduction in emissions (including a reduction in emissions from natural gas) since at least 2016."

Question(s):

a) Is it Dr. Hopkins' testimony that the energy transition started for Enbridge Gas in Ontario in 2016 or earlier?

b) In Dr. Hopkins' opinion, has the pace of the energy transition remained about the same since 2016, or has it accelerated in recent years? Please elaborate.

M8-EGI-79

Reference:

Exhibit M8, page 25
Exhibit I.5.3-STAFF-204, Attachment 1
Technical Conference Transcript Day 8

Preamble:

At page 25, Dr. Hopkins states:

"In fact, Concentric cites Enbridge's 2021 Sustainability Linked Bond (SLB) issuances as an example of the impact of investors' ESG concerns, and this shows a small reduction in the cost of debt for Enbridge."

Enbridge Gas seeks to clarify that Enbridge Inc, and not Enbridge Gas has issued Sustainability Linked Bonds.

Exhibit I.5.3-STAFF-204, Attachment 1 contains the Enbridge Inc prospectus for Sustainability Linked bonds.

At TC Tr. Vol 8 page 7, lines 7 to 9, Mr. Reinisch states:

"As of right now we have not yet issued a sustainability linked bond for EGI. Our sustainability-liked debt has been issued out of Enbridge Inc."

Question(s):

Please confirm that only Enbridge Inc., the parent company of Enbridge Gas, has issued Sustainability Linked Bonds and that Enbridge Gas has not issued Sustainability Linked Bonds?

M8-EGI-80

Reference:

Exhibit M8, page 27

Preamble:

At page 27, Dr. Hopkins states:

“As a result, Massachusetts gas utilities and their regulators have a better sense of their future and path through the energy transition than other gas utilities. In short, and contrary to Concentric’s claims, regulatory attention to energy transition issues reduces uncertainty and lowers risk.”

Question(s):

Please explain how regulatory attention to energy transition issues necessarily reduces uncertainty and lower risk for gas utilities if the policy environment in a state or province requires strict reductions in carbon emissions by a date certain, provides incentives for fuel switching, requires the use of electricity in new buildings, or imposes restrictions or outright bans on natural gas usage.

M8-EGI-81

Reference:

Exhibit M8, pages 33 and 45

Preamble:

At page 33, Dr. Hopkins states:

“While gas had a greater advantage over electricity in 2015, the overall effect of change in electricity and natural gas bills from 2015 to 2022 is to leave natural gas with a noticeable continuing advantage.”

At page 45, Dr. Hopkins states:

“Proactive planning regarding asset retirements, with depreciation approaches tailored to assets retiring in any given year, can reduce and potentially eliminate stranded cost risks—even in a case that has a more extreme version of building sector departure from the gas system than modeled by Guidehouse in its electrification case.”

Question(s):

a) Would Dr. Hopkins agree that the relative price of natural gas and electricity from 2015-2022 is not the only relevant consideration in assessing competitive risk?

b) Has Dr. Hopkins considered whether other factors such as environmental regulations, financial incentives, and policy considerations will also affect the competitive position of natural gas relative to electricity on a going forward basis? If so, what do those other factors indicate? If not, why not?

c) Has Dr. Hopkins considered the aggregate effect on natural gas prices in Ontario of the increased carbon tax, if combined with accelerated depreciation? If so, please discuss how these modifications would affect the competitiveness of natural gas relative to electricity on a going-forward basis.

d) The report filed by Mr. Chris Neme on behalf of GEC and ED suggests that both the "death spiral" and stranded assets are high probability events for Enbridge Gas by 2050. Assuming this is true, how does this change Dr. Hopkins' assessment of competitive risk for Enbridge Gas?

M8-EGI-82

Reference:

Exhibit M8, page 35

Preamble:

At page 35, Dr. Hopkins states:

"Risk is composed of the combination of likelihood and consequence. A capital risk analysis should include identification and analysis of the circumstances under which a utility would fail to recover its invested capital along with a fair return, the extent of the shortfall, and the likelihood of such circumstances. The most obvious way to conduct such an analysis would be through scenario analysis."

Question(s):

a) Is it Dr. Hopkins' position that equity investors regularly perform the analysis he describes on pages 35-39 of his report in assessing risk related to investing in local gas distribution companies such as Enbridge Gas? If so, please provide examples with citations to such analyses.

b) Is it Dr. Hopkins' position that S&P performs the analysis he describes on pages 35-39 of his report in assessing business risk for local gas distribution companies such as Enbridge Gas? If so, please provide citations to S&P reports demonstrating such analyses.

M8-EGI-83

Reference:

Exhibit M8, page 47
Exhibit I.1.8-STAFF-14, Attachment 6, pages 47-57.

Preamble:

At page 47, Dr. Hopkins states:

"EGI is arguing that its consultants know better than S&P and that its business risk has increased despite S&P not identifying that risk in rating reports for the company. My analysis shows that EGI faces small, if any, capital risk from an ambitious electrification scenario; this aligns with S&P's silence regarding this risk."

At Exhibit I.1.8-STAFF-14, page 47, The S&P Global Ratings Report refers to the Outlook period used in the credit opinion:

"We expect Enbridge Gas Inc. (EGI) to maintain its financial performance throughout our two-year outlook period."

At Exhibit I.1.8-STAFF-14, page 48, The S&P Global Ratings Report refers to the Outlook period used in the quantitative evaluation of Enbridge Gas' FFO to debt credit metric:

"This leads us to forecast FFO to debt of 11%-12% during our two-year outlook period."

Question(s):

a) Does Dr. Hopkins agree that equity investors do not necessarily consider the same risk factors as credit rating agencies in evaluating the business and financial risk of a regulated utility such as Enbridge Gas? If he does not agree, please explain why not.

b) Please confirm that the outlook period used by S&P in its report dated July 21, 2022 covers only a two-year period.

c) Does Dr. Hopkins agree that the S&P reports relied upon in his response to question 76 on page 47 do not include any references to risks facing Enbridge Gas in the 2025-to-2028 time horizon?

M8-EGI-84

Reference:

Exhibit M8, page 52
Exhibit I.5.3-ED-143

Preamble:

At page 52, Dr. Hopkins states:

"Without a comprehensive understanding of the risks and the utility's plan to mitigate them, it would be inappropriate to reward the company's shareholders with a greater equity share and thereby charge ratepayers a higher rate to compensate the utility for risks that may not occur, and that prudent utility management could mitigate."

In Exhibit I.5.3-ED-143, question part b) states:

"Please describe in simple terms how increasing the equity ratio helps Enbridge to (i) mitigate risks or (ii) be compensated for assuming higher risks?"

Response to interrogatory:

i. Credit rating agencies and debt investors evaluate the riskiness of investing capital in Enbridge Gas. The higher the equity ratio, the lower the risk to debt holders. With increasing business risks to Enbridge Gas as a result of factors such as Energy Transition, the riskiness of investing in Enbridge Gas's debt, all else being equal, increases. Higher equity thickness would offset the increased business risks. Therefore, increased equity thickness would support Enbridge Gas's continued access to capital at reasonable costs.

ii. Increasing the equity thickness does not compensate Enbridge Gas for assuming higher risks. The return on equity compensates equity investors for assuming risk and Enbridge Gas is not proposing to change the OEB's prescribed Return on Equity formula.

Question(s):

a) Please confirm that the applicant's proposal to increase equity thickness will increase the amount of capital shareholders have at risk.

b) Does Dr. Hopkins agree that all else being equal, an increase in equity thickness reduces the riskiness of investing in Enbridge Gas debt, and thus benefits debt investors?

M8-EGI-85

Reference:

Exhibit M8, page 53

Preamble:

At page 47, Dr. Hopkins states:

"Without a comprehensive understanding of the risks and the utility's plan to mitigate them, it would be inappropriate to reward the company's shareholders with a greater equity share and thereby charge ratepayers a higher rate to compensate the utility for risks that may not occur, and that prudent utility management could mitigate. Paying more now, without taking prudent actions to reduce the need to pay more later, is neither just nor reasonable."

Question(s):

a) In Dr. Hopkins' opinion, is it important for Enbridge Gas to have the financial strength it needs to manage the effects of the energy transition as well as other business risks?

b) If requesting a higher deemed equity ratio is one way for Enbridge Gas to prudently manage the energy transition in order to reduce the need to pay more later, why would Dr. Hopkins object to such a proposal?

M9-EGI-86

Reference:

Exhibit M9, page 4

Preamble:

At page 4, Energy Futures Group states:

"It is also consistent with an analysis of the availability and feasibility of the electric and gas technologies required for net zero greenhouse gas (GHG) emissions and the current cost effectiveness of electrification."

Question(s):

Please provide the referenced study and analysis.

M9-EGI-87

Reference:

Exhibit M9, page 4

Preamble:

At page 4, Energy Futures Group states:

"The report is authored by Chris Neme, a Principal with Energy Futures Group (EFG). Mr. Neme and his firm are leading experts on the implications of decarbonization for gas customers and best practices to address those implications."

Question(s):

a) Please provide all papers, research and other documentation demonstrating expertise of the author in the area of RNG, hydrogen, CCUS, and feasibility of converting industrial customer technologies and processes to these fuels/technologies.

b) Are the papers provided in part a) peer reviewed?

M9-EGI-88

Reference:

Exhibit M9, page 5

Preamble:

At page 5, Energy Futures Group states as one of its recommendations to the OEB:

"3. Require all new connections to be net-zero greenhouse gas emitting. This would include requiring that all new connections install hybrid heating systems with a cold climate air source heat pump meeting the vast majority of heating needs (and a back-up gas furnace functioning only during the coldest hours of winter)."

Question(s):

Please provide references to the parts of the Acts and Regulations that govern the OEB that provide the OEB with the jurisdiction to mandate what heating equipment can be installed in a building.

M9-EGI-89

Reference:

Exhibit M9, page 8

Preamble:

At page 8, Energy Futures Group states:

"Most independent decarbonization pathways studies find that high levels of full electrification of buildings will be the least expensive decarbonization pathway."

Question(s):

a) Please provide a list of independent decarbonization pathways studies for North America that show electrification will be the least expensive decarbonization pathway. Please provide copies or links.

b) Please provide a list of all decarbonization pathway studies that are focused on or include Ontario or any other Canadian jurisdiction, regardless of preferred/recommended pathway. Please provide copies or links.

M9-EGI-90

Evidence Reference:

Exhibit M9, page 8

Preamble:

At page 8, Energy Futures Group states:

"Full electrification of homes is already highly cost-effective from a consumer price perspective in comparison to fossil methane heating, lowering total energy bills by 35-49% in the very first year and providing nearly $16,000 in 18-year net present value (NPV) savings. Full electrification will likely be even more cost-effective in comparison to decarbonized gas heating (e.g., RNG)."

Question(s):

Please provide sources or references for these cost comparisons including working papers and Excel spreadsheets.

M9-EGI-91

Reference:

Exhibit M9, page 8

Preamble:

At page 8, Energy Futures Group states:

"Even scenarios with significant hybrid gas-electric heating result in declines in gas demand because RNG feedstocks are expensive and very limited and the amount of hydrogen energy that can be safely blended with methane is very small."

Ontario released its Low-Carbon Hydrogen Strategy[1] in 2022 that outlines how hydrogen will play a key role as a clean and safe energy resource for Ontario. The Federal government also released Hydrogen Strategy for Canada[2] that lays out an ambitious framework for actions that will solidify hydrogen as a tool to achieve Canada's goal of net-zero emissions by 2050 and position Canada as a global, industrial leader of clean renewable fuels.

Question(s):

Please explain whether these governmental strategies were taken into consideration in Energy Futures Group's views related to hydrogen, and if so, how?

M9-EGI-92

Reference:

Exhibit M9, pages 8-9

Preamble:

At pages 8 and 9, Energy Futures Group states:

"The country's 2030 Emissions Reduction Plan is designed to reduce emissions from the buildings sector by 42% relative to 2019 levels."

Question(s):

Please confirm that the province of Ontario has not set a target for GHG reductions from the building sector. If GEC, ED or Mr. Neme disagrees, please provide a link to or a copy of any documents that show otherwise.

M9-EGI-93

Reference:

Exhibit M9, page 12

Preamble:

At page 12, in reference to a study by the Canadian Climate Institute, Energy Futures Group states:

"The study acknowledges that there is greater uncertainty with regard to the mix of technologies and fuels that will ultimately comprise the optimal solution to decarbonization by 2050. For example, it states that electric heating systems will heat between 52% and 100% of homes by 2050 (up from about 30% today), with the balance being met by wood (0% to 10%) and clean gases (0% to 40%).[10]"

"However, the study notes that there are a number of barriers to clean gases playing even that large of a role. With respect to hydrogen, barriers include high costs, limits to

the ability to blend hydrogen with methane, the “significant modifications to pipelines and distribution networks” required to carry more hydrogen than that, and the need to replace methane-burning equipment in homes and businesses with hydrogen-burning equipment. With respect to biomethane, the key barriers are both high cost and “limited” supplies of feedstock “making significant cost declines from economies of scale unlikely.”[12] The bottom line is that “the future of clean gases in the buildings sector is complex and uncertain.”[13]”

Question(s):

a) In the report by the Canadian Climate Institute, what are the barriers discussed regarding electrification of buildings?

b) Please confirm that the referenced report states that the percentage of Canadian homes heating with electric heat pumps in 2035 is approximately 15 to 18%.

c) Regarding hydrogen and renewable natural gas, please confirm that the referenced report states the following:

    i. A promising option for reducing emissions cost-effectively in older buildings is clean gases such as hydrogen or RNG.
    ii. The costs of hydrogen could decline by 40 to 50 percent over the next decade and up to 70 percent by 2050.
    iii. New technologies that use second-generation feedstocks could potentially drive down costs and increase supply of RNG.
    iv. By 2050, clean gases could potentially provide a total amount of energy equivalent to 32 percent of today’s natural gas demand from Canada’s buildings.
    v. The scenarios modeled in this report did not include dedicated hydrogen pipelines due to modelling limitations, which may mean hydrogen’s potential contribution to final energy demand has been underestimated.

d) Please confirm that in the referenced report, the sentence that states: “The future of clean gases in the buildings sector is complex and uncertain” is followed by the following: “But the gas distribution network looks likely to play a role in helping Canada’s built environment reach net zero. At a minimum, it can help to reduce emissions from Canada’s older buildings over the medium term by blending in clean gases with natural gas, which can act as a helpful bridge to either eventual electrification or higher rates of blending”.

M9-EGI-94

Reference:

Exhibit M9, page 12
Canada Energy Regulator, Provincial and Territorial Energy Profiles, March 10, 2023[4]
Énergir website, Natural gas distribution[5]
Gazifère website, About Us[6]
Exhibit 1, Tab 2, Schedule 1, page 7

Preamble:

At page 12, Energy Futures Group states:

"As Figure 1 shows, the study concluded that natural gas use (systeme au gaz naturel) for residential space heating would be cut roughly in half by 2030 (relative to 2016) and essentially disappear by 2050. Fuel oil (systeme au mazout) and wood heating (poele a bois ou aux granules) also large disappear by 2050 in the decarbonization scenarios (Trajectories A, B, C and D). There is no hydrogen use in the residential sector in any scenario. Nor is there any appreciable use of biomethane. All space heating essentially becomes electric."

CER's website states:

"Ontario consumed an average of 2.7 Bcf/d of natural gas in 2020."[7]
"The residential and commercial sectors each consumed 0.8 Bcf/d."[8]

"In 2020, Quebec consumed an average of 587 million cubic feet per day (MMcf/d) of natural gas."[9]
"The commercial and residential sectors consumed 157 MMcf/d and 65 MMcf/d, respectively."[10]

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[4] Canada Energy Regulator, Provincial and Territorial Energy Profiles, March 10, 2023, https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/
[5] Energir. Natural gas distribution. https://energir.com/en/about/our-energies/natural-gas/natural-gas-distribution
[6] Gazifère. About Us. 2023. https://gazifere.com/en/about-us/
[7] Canada Energy Regulator, Provincial and Territorial Energy Profiles - Ontario, March 3, 2023, https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-ontario.html
[8] Ibid.
[9] Canada Energy Regulator, Provincial and Territorial Energy Profiles - Quebec, March 3, 2023, https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/provincial-territorial-energy-profiles/provincial-territorial-energy-profiles-quebec.html
[10] Ibid.

Énergir's website states:

"Its underground network spans more than 11,000 km and serves just over 205,000 customers."[11]

Gazifère website states:

"Serving more than 43 500 residential, commercial, institutional and industrial customers, Gazifère owns and operates a 1 000 km gas supply system."[12]

At page 7, Exhibit 1, Tab 2, Schedule 1 states:

"[Enbridge Gas] serves over 3.8 million residential, commercial, and industrial customers across the province" … "through 153,000 km of natural gas transmission and distribution pipelines"

Question(s):

a) Based on data provided by the Canada Energy Regulator, please confirm that the volume of natural gas used in residential buildings in Ontario was 12x the volume of natural gas used in Quebec in 2020.

b) Based on the information provided on the Énergir and Gazifère websites, and Enbridge Gas evidence, please confirm that the natural gas system in Ontario serves approximately 15x the number of customers and has 13x the amount of pipeline infrastructure as the natural gas system in Quebec.

c) Please provide any data on and compare the amount of energy delivered by the gas and electricity systems in Ontario and Quebec on a peak day. Please include sources for any assumptions.

M9-EGI-95

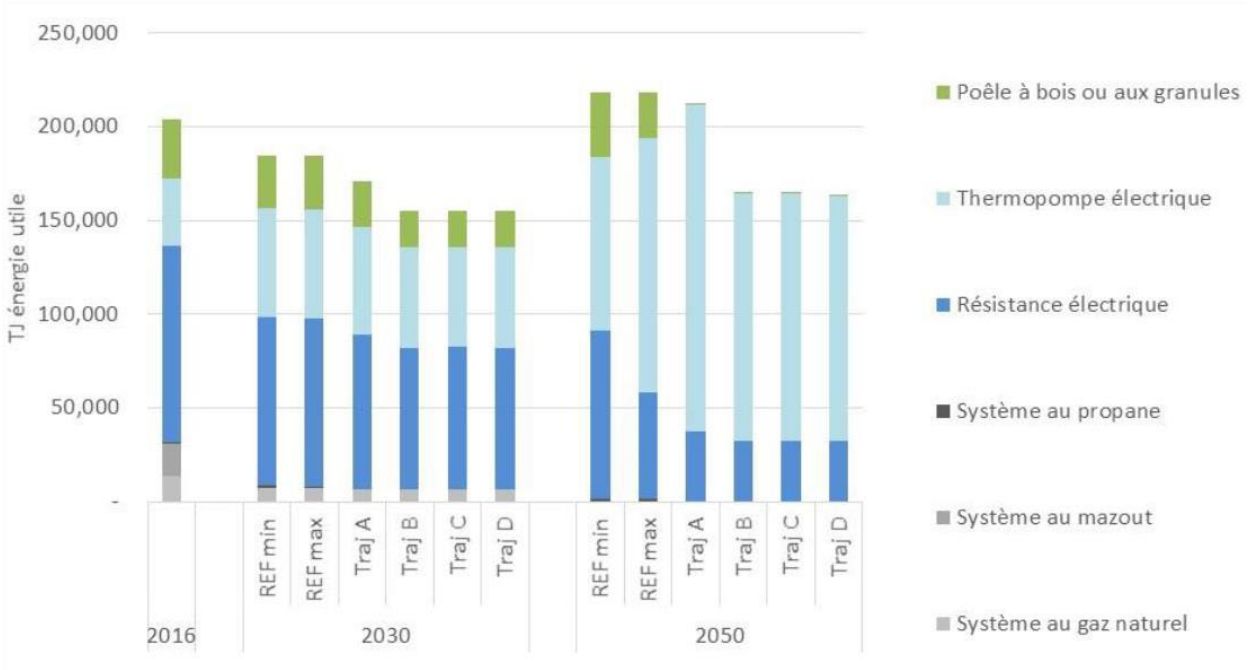
Reference:

Exhibit M9, page 13, Figure 1

Preamble:

Figure 1: Quebec Decarbonization Study, Forecast Change in Residential Heating Fuel Mix[15]

[11] Energir. Natural gas distribution. https://energir.com/en/about/our-energies/natural-gas/natural-gas-distribution
[12] Gazifère. About Us. 2023. https://gazifere.com/en/about-us/



Question(s):

a) Please provide English translations of each energy type for Figure 1.

b) Please confirm that the vast majority of residential space heating in Quebec is currently provided by electricity.

c) Please confirm that the replacement of electric heating with gaseous heating (including hydrogen) was not considered in the Dunsky report due to the significant existing penetration of electric residential space heating.

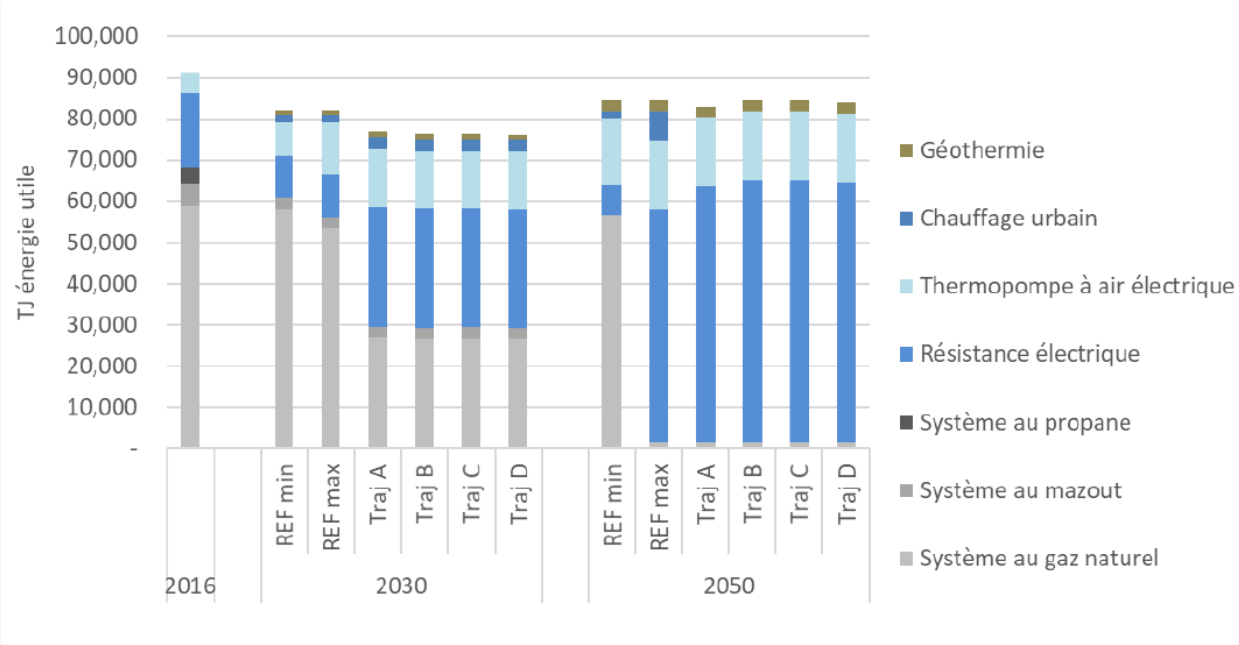
M9-EGI-96

Reference:

Exhibit M9, page 13, Figure 2

Preamble:

Figure 2: Quebec Decarbonization Study, Commercial and Institutional Buildings Heating Fuel Mix[17]



Question(s):

a) Please provide English translations of each energy type for Figure 2.

b) Please confirm that the Dunsky report projects that the vast majority of commercial space heating in Quebec will be electric resistance heating and that air-source and ground-source heat pumps have a limited role in commercial space heating by 2050.

M9-EGI-97

Reference:

Exhibit M9, page 17

Preamble:

At page 17, Energy Futures Group states:

“Delivery of 100% hydrogen delivery to residential and commercial buildings is generally seen as so unrealistic that it typically isn’t even analyzed.”

Question(s):

For each of the studies summarized in Section III.3, please provide a reference showing where in each report 100% hydrogen is stated to be unrealistic and provide any reasons why it was found to be unrealistic for inclusion in the analysis in the jurisdiction studied.

M9-EGI-98

Reference:

Exhibit M9, page 20

Preamble:

At page 20, Energy Futures Group states:

"And while substations and other elements of the electric distribution system may need to have capacity upgrades when enough customers electrify, some parts of the electric distribution system will likely be able to accommodate significant electrification without such upgrades…"

Question(s):

Please provide references to reports or studies that show "some parts of Ontario's electric distribution system will likely be able to accommodate significant electrification without such upgrades…" and what percentage of the total Ontario electric distribution system these areas account for.

M9-EGI-99

Reference:

Exhibit 9, pages 22 and 24

Preamble:

At page 22, Energy Futures Group states:

"I assume that the customer fully electrifies at the time that it would otherwise be replacing both its gas furnace and central air conditioner. This requires additional capital costs for a new electric heat pump water heater, new electric induction stove and new electric dryer – costs that would not be incurred for another six or seven years if the customer continued to use gas equipment for such end uses.[49]"

At page 24, Energy Futures states:

"My analysis did not assume and an electric panel upgrade would be required. Some homes will need such upgrades; others will not. However, the cost of panel upgrades -

$2000 or less on average[50] – would not significantly change the conclusion that electrification is very cost effective for customers.

Question(s):

a) Please confirm if costs related to building envelope upgrades and ducting upgrades have been included in the analysis provided in Section 5.A.

b) If not already included, please update the analysis to include costs related to electric panel upgrades, internal wiring, building envelope upgrades and ducting upgrades that are required in order to install air source heat pumps in some homes.

c) Please provide an analysis demonstrating that a house built with gas and water heating as the primary source of energy and built with a 100 amp electrical panel could convert to 100% electricity as a fuel source without upgrading the panel or other infrastructure within the home. If no analysis can be provided, please provide a reference to a study in a comparable weather zone to Ontario.

M9-EGI-100

Reference:

Exhibit M9, page 23, Tables 2 & 3

Question(s):

a) Please provide all tables and live Excel documents with formulae intact for all calculations associated with Tables 2 and 3.

b) Please provide all assumptions used to develop the analysis presented in Tables 2 and 3.

c) Please explain how the data within Tables 2 and 3 were derived and provide all sources.

M9-EGI-101

Reference:

Exhibit M9, pages 24-25

Preamble:

At page 25, Energy Futures Group states:

“As with all commodity markets, the most expensive source of RNG will ultimately set the market clearing price for all RNG.”

Question(s):

Please provide a reference for this statement.

M9-EGI-102

Reference:

Exhibit M9, pages 30-31

Preamble:

Energy Futures Group observed that the Guidehouse analysis used performance degradation assumptions for air-source heat pump systems based on an NREL publication from 2006. Energy Futures Group discounted the findings of this publication based on the age of the study, and conjectured that newer variable-speed systems might show lower rates of performance degradation.

Question(s):

a) Please provide supporting evidence showing how the addition of a variable speed compressor and controls serves to reduce performance degradation, compared with older single-speed heat pump technology.

b) Please provide supporting evidence showing how a variable-speed heat pump is less susceptible to performance degradation due to improper refrigerant charge and evaporator coil air flow compared with older heat pump technology.

M9-EGI-103

Reference:

Exhibit M9, pages 37-38

Question(s):

a) What are current and historical annual sales of HPWHs in Ontario?

b) What quantity of heat pump water heater sales does Energy Futures Group project for Ontario in 2030, 2040, and 2050?

c) Please provide evidence to support your projections.

M9-EGI-104

Reference:

Exhibit M9, page 50, Table 10

Preamble:

Table 10: Equipment Cost, Efficiency and Energy Consumption Assumptions

	2023 Initial Capital Cost	Life	Level-ized Annual Cost	2023 Avg Heating COP	2030 Avg Heating COP	Avg Cooling SEER	Other COPs	Annual Gas m^3	Annual Electric kWh			
									Heating	Cooling	Other	Total
Heating/Cooling												
Current Avg Furnace + Central A/C				0.90		13		2117	328	779		1,107
New Gas Furnace + Central A/C	$8,000	18	$632	0.95	0.95	14		2006	328	723		1,051
cold climate ASHP	$4,600	18	$363	2.84	2.93	18			7,279	563		7,842
Water Heating												
Current Stock Avg gas water heater							0.63	441				-
Gas Water Heater	$5,089	13	$510				0.80	347				-
Heat Pump Water Heater	$2,796	13	$280				3.19		946			946
Drying												
Gas Dryer	$1,560	13	$156				3.48	53			108	108
Electric Dryer	$1,093	13	$109				3.93				608	608
Cooking												
Gas stove	$1,094	12	$117					94				-
Electric Induction Stove	$1,494	12	$159								290	290

Question(s):

a) Please provide a copy of the table in Excel with any equations intact.

b) Please explain how the data within Table 10 was derived and provide all sources.

c) For gas water heating, was a tankless water heater and its cost and efficiency, considered?

d) For the cold climate ASHP:
   i. Was a ductless system or ducted system considered?
   ii. Was the cost of an air handler included?
   iii. Was the cost of an electric resistance backup contemplated?

iv. Were the costs of all necessary upgrades to internal wiring, breakers, and panel included?

Please state all assumptions used and references for the sources.

M9-EGI-105

Reference:

Exhibit M9, Appendix A, page 50, Table 10

Question(s):

Please provide the source of information for all amounts/estimates included in Table 10 and confirm units referenced and any underlying assumptions. If amounts are derived, please provide the numerical calculation and accompanying assumptions to support the values in the table.

M9-EGI-106

Reference:

Exhibit M9, Appendix A, page 50, Table 11

Question(s):

a) Please provide the source of information for all amounts/estimates included in Table 11 and any underlying assumptions.

b) Please explain the purpose of the table and the applicability of gas and electricity prices that are held static over the forecast period.

M10-EGI-107

Reference:

Exhibit M10, page 3

Preamble:

At page 3, Dr. Howarth and Dr. Jacobson state:

"Further, although GWP100 is still used more frequently in greenhouse gas inventories by governments, this is a political decision dating back to the early 1990s when our knowledge of the critical role of methane in the climate system was quite limited, and the IPCC has noted that "there is no scientific argument for 100 years…."."

Question(s):

a) Please confirm that the Government of Canada uses the GWP100 in its National Inventory Report, which is used as the basis for setting and tracking Canada's GHG reduction targets in 2030 and beyond.

b) Do the authors agree that in order to compare the GHG impact of an activity, fuel or technology to the Canadian GHG reduction targets, that a common GWP must be used? Please explain your answer.

M10-EGI-108

Reference:

Exhibit M10, pages 4-5

Preamble:

At page 4, Dr. Howarth and Dr. Jacobson states:

"In addition, we performed sensitivity analyses down to a value of 1.54%, the lowest reasonable rate supported by any independent studies."

At page 5, Dr. Howarth and Dr. Jacobson states:

"The leakage rates relied on in that report (0.6% or 0.16%) are not credible and are not consistent with the current scientific understanding of methane emissions from gas extraction."

Question(s):

Please confirm the 2023 paper published in Nature by authors Johnson, Conrad, and Tyner titled “Creating measurement-based oil and gas sector methane inventories using source-resolved aerial surveys”, which provides a value of 0.38% methane leakage rate for British Columbia, based on top-down measurements, is a peer-reviewed independent study that contributes to the current scientific understanding of methane emissions from gas extraction.

M10-EGI-109

Reference:

Exhibit M10, pages 9-11

Preamble:

At pages 9 and 10, Dr. Howarth and Dr. Jacobson states:

“Top–down estimates use information such as from satellites or airplane flyovers that characterize an integrated flux. The mean value of estimates from 20 different studies in 10 major natural gas fields in the United States, normalized to gas production in those fields, indicates that 2.6% of gas production is emitted to the atmosphere.[16] This is a good estimate for the upstream emissions that occur in the gas fields. Methane is also emitted from storage and transport to consumers, and the data in the top–down study of Plant et al[23] suggests this is an additional 0.8%.[16, 24]”

Question(s):

a) Please provide the average methane emission rate for each of the production/extraction, gathering and boosting, processing, transmission, storage, and distribution segments as they contribute to a total rate of 3.5%, and how these rates were derived for each segment.

b) What timeframe does the estimated average US methane emission rate of 3.5% represent? In what year, were the specific measurements that inform the methane emission rate collected? Please provide this information according to production/extraction, gathering and boosting, processing, transmission, storage, and distribution segments.

c) Please discuss the specific processes (e.g., extraction, gathering, processing) represented in the 2.6% methane emission rate for the “upstream” natural gas supply chain, and confirm that methane emission rates were normalized to production in 2015. Please discuss the use of 2015 production volumes as it relates

to the year of observation from the studies used to estimate methane emissions rates.

d) Please discuss each method of top-down methane emission measurement undertaken by authors Peischl et al. (2013, 2015, 2016, 2018), Karion et al.(2015), Caulton et al.(2014), Barkley et al.(2017), Ren et al.(2019), Schneising et al. (2014, 2020), Zhang et al. (2020) and how comparable the results are between the various aerial and satellite measurement methods undertaken in each study and how other potential anthropogenic or biological sources of methane were excluded from these measurement methods. Please discuss the variability of methane emission rates for the Marcellus basin between studies conducted by Barkley et al. (2017), and Ren et al. (2019).

e) Please confirm the 0.8% of methane emissions representing storage and transportation was based on aerial measurements conducted by Plant et al, of Northeastern US urban centers in 2018 and which segments of the natural gas supply chain (i.e., storage, transmission, distribution, end-use) are represented by the data collected, and how the measurement method allows for attribution to each distinct segment of the natural gas supply chain and excludes other anthropogenic or biological sources of methane?

f) Please discuss why the results of the Plant et al. study area were scaled to the United States, when Plant describes the study areas as “old and leak prone” and when Howarth (2020) indicates “This estimate may or may not apply to the entire United States” and how these results may compare to Ontario, and the relevancy of methane emissions in the distribution system when a blue hydrogen facility is most likely to be supplied at the transmission level?

M10-EGI-110

Reference:

Exhibit M10, page 10

Preamble:

At page 10, Dr. Howarth and Dr. Jacobson states:

“Note that in addition to some methane being lost between production and consumption due to leaks, methane is also burned by the natural gas industry to power natural gas processing and transport. This is important to consider, since we want to evaluate how much methane is emitted for the methane in natural gas that is consumed in producing hydrogen. In 2015, natural gas production in the United States was 817 billion m^3, while

consumption was 771 billion m^3,[25,26] (converting cubic feet to cubic meters). Using this information, we can estimate the methane emission as a percentage of gas consumption as follows:

(3.4% of production) $*$ (817×109 m^3⁄771×109 m^3)
= 3.5% of consumption."

Question(s):

a) Is the 817 billion m^3 of 2015 natural gas produced in the U.S. based on marketed production, and if not, confirm what this value represents?

b) Please provide the 2015 dry production of natural gas in the U.S. and discuss which phase of production (dry or marketed) best reflects the final stage of natural gas production (i.e., post producers gate) entering the transportation and storage phases of the natural gas lifecycle.

c) Please comment on how the ratio of production[13] to consumption[14] accurately represents gas used in processing and transporting natural gas, and how this ratio is influenced by importing and exporting natural gas. Please indicate to what degree this ratio has changed over the last 20 years, or is expected to change in the future.

M10-EGI-111

Reference:

Energy Science & Engineering, Comment on "How green is blue hydrogen?", March 29, 2022.[15]

Energy Science & Engineering, Blue hydrogen must be done properly, June 23, 2022.[16]
Royal Society of Chemistry. On the climate impacts of blue hydrogen production. November 21, 2021.[17]

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[13] U.S. Energy Information Administration. U.S. Dry Natural Gas Production. https://www.eia.gov/dnav/ng/hist/n9070us2a.htm
[14] U.S. Energy Information Administration. U.S. Natural Gas Total Consumption. https://www.eia.gov/dnav/ng/hist/n9140us2a.htm
[15] Energy Science & Engineering, Comment on "How green is blue hydrogen?", March 29, 2022. https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.1126
[16] Energy Science & Engineering, Blue hydrogen must be done properly, June 23, 2022. https://onlinelibrary.wiley.com/doi/full/10.1002/ese3.1126
[17] Royal Society of Chemistry. On the climate impacts of blue hydrogen production. November 21, 2021. On the climate impacts of blue hydrogen production - Sustainable Energy & Fuels (RSC Publishing) DOI:10.1039/D1SE01508G

Question(s):

Please confirm the above referenced papers are also peer reviewed studies on the GHG emissions from blue hydrogen production.